

## PROCEEDINGS.

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MEETING, IN THE THEATRE OF THE INSTITUTE OF CIVIL ENGINEERS,  
23, GREAT GEORGE STREET, WESTMINSTER, LONDON,  
ON THURSDAY, JUNE 1ST, 1876.

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LINDSAY WOOD, ESQ., PRESIDENT, IN THE CHAIR.

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### ON THE LARGER DIVISIONS OF THE CARBONIFEROUS SYSTEM IN NORTHUMBERLAND.

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BY G. A. LEBOUR, F.G.S. LONDON AND BELGIUM, F.R.G.S., ETC.

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#### INTRODUCTION.

"OF all formations, the Carboniferous has, perhaps, suffered the most, from a tendency to give undue weight to local peculiarities, and to separate, as distinct sections, those members which, in reality, have only a limited range and importance—the Yellow Sandstone, the Mountain Limestone, the Calp, the Coal Measures, and the Millstone Grit, becoming by turns the prominent local object, although they are all parts of one great system, characterized by the frequent recurrence of vegetable matter, and by a remarkable combination of limestones, shales, and sandstones, either of which may in turns become the predominant member of the system."\*

These words of General Portlock should be taken to heart by every one pretending to enter the field of Carboniferous geology, and the writer thus prefixes them to the present paper in order to show that, although he is now dealing with a limited area, he yet has no wish to extend the conclusions he has arrived at, as to the Carboniferous Series within it, to other regions, or, in other words, to argue from the particular to the general.

\* Gen. Portlock's "Geol. Report on Londonderry, etc." Dublin, 1843, p. 573.

The detailed mapping of outcrops has one possible consequence which is apt to be overlooked. This may be best illustrated, perhaps, by a case common in alluvium mapping. The observer begins by following the base of a valley-flank. The line is at first as clear as possible, and seems to continue so, but after walking along it some distance, and on relaxing his attention, he is surprised to find himself at a level much higher than that at which he began, the true alluvium which he intended to map is far below him, and his line is seen to be now merely that of gravel terrace divisions, which by gradual blending, first with the alluvium, and then among themselves, have insensibly drawn him from the loamy river flat. On a much larger scale this is what sometimes tends to happen in carrying boundary lines between great rock-series across wide areas—lines are run on from districts in which they mark important changes into others where none take place.

It is by considering what divisions of such a great series are legitimate in each separate area that the range of the boundary lines can be checked, and when this is done with some degree of completeness, the more general recognition of the following geological truth may be looked for, viz. :—that hard and fast lines cutting up the geological column in any locality are, or have at some time been, invariably replaced by insensible passage beds in some other region. "Mountains are not to be studied with a microscope," said De Saussure, but the details could be ill spared on which any large view of stratigraphy must be based to be worth anything.

#### PREVIOUS VIEWS ON THE SUBJECT.

In Winch's classic paper\* the only divisions recognized in the Carboniferous are the Coal Measures and the Lead Mine Measures, or Mountain Limestone.

In 1824 William Smith† called the lower part of Winch's upper division "Millstone Grit," and set apart the top portion of the lower one as "alternations of grits and shales, with a thin limestone and coal between the Millstone Grit and the Metalliferous Limestone," the latter being his term for the Lead Mine Measures of Winch.

Westgarth Forster in 1821‡ adopted for the rocks between Alston and Newcastle the three orthodox divisions—Coal Measures, Millstone Grit, and Lead Measures.

\* N. J. Winch. "Observations on the Geology of Northumberland and Durham" [1814].—*Geol. Soc. Trans.* iv., 1817, pp. 1—101.

† "Geological Map of Durham." London, 1824.

‡ "Section of the Strata," etc. By Westgarth Forster. 1821.

The late Mr. George Tate, of Alnwick, divided the Northumbrian series in 1855 thus :—Coal Measures, Millstone Grit, Carboniferous Limestone Series (in two parts—*a* Calcareous and *b* Carbonaceous), Tuedian (= Calciferous Sandstone of Maclaren, 1839), and Upper Old Red Conglomerate.\*

In 1863 Messrs. Howse and Kirkby† grouped the Carboniferous rocks of Durham and Northumberland under the following heads:—First, Coal Measures (including part of the Permian series). Second, Millstone Grit. Third, Yoredale Rocks. Fourth, Scar Limestone series. Fifth, Tuedian beds.

Up to the present time the divisions adopted by the Geological Survey for the northernmost county are—Coal Measures, Gannister beds, Millstone Grit, Carboniferous Limestone Series (including some beds above the highest limestone). The latter member will in course of time probably be subdivided, but the writer is not aware of any term or limits having been yet adopted by the Survey authorities respecting anything below its upper beds in this region.

#### THE COAL MEASURES.

The top division, the Coal Measures, is recognized by all. Its limits are sufficiently clear, although something has been done to obscure them by those authors who would unite to it the friable yellow sands and red sandstone of the unconformable Permian above. This proposal has not been generally accepted, and resting, as it does, only upon the presence of a few plants of Carboniferous species in the red bed, was rejected after careful consideration by Sir Roderick Murchison, Mr. Aveline, and other competent observers,‡ and this rejection has since been embodied in the published maps of the Geological Survey.

The true highest bed of the Coal Measures we are, of course, unacquainted with, owing to the unconformity of the overlying Permians, but all the beds between the base of the latter and the Brockwell seam inclusive, are acknowledged Coal Measures.

\* See Geological Map in Tate's "History of Alnwick," 1869, and previous papers in the publications of the Berwickshire Naturalists' Field Club.

† Synopsis of the Geology of Durham and part of Northumberland." Newcastle, 1863, p. 19.

‡ See Murchison's "Siluria," 4th edition, 1867, p. 328. He there says:—"I do not admit that the occurrence of a few Plants, said to be of Carboniferous species, in the underlying red sandstone at Tynemouth affects any conclusions as to the true base of the Permian."

## GANNISTER BEDS.

There is, however, some difference of opinion as to the classificatory value of the next set of beds, the so-called Gannister series. The question is comparatively unimportant, and is simply this :—Do these beds belong to the Coal Measures or to the Millstone Grit, or do they form a neutral series of passage beds from the one to the other? Beyond their lithological character—a deceptive one at best—these beds have little or nothing to distinguish them. Had their recognition as a distinct horizon not begun where this lithological character is much more marked than with us, as in Yorkshire and in Derbyshire, there would probably have been no question of their attaining the dignity of a separate division. In the Coal-field they derive an importance not their own, from the fact that they underlie what is commonly looked upon as the lowest workable seam of coal. It will perhaps be safest to admit the Gannister beds in Northumberland as a small subdivision of the Coal Measures. But in allowing them a place in the local Carboniferous series, the writer deprecates the position accorded to it in the Government maps of our county, where, by giving them a special colour, a value in the column equal to that of the greater Carboniferous divisions is implied. To adopt for the nonce the language of Biology, the writer would prefer to consider the Gannisters as a sub-genus of the genus Coal Measures.

## MILLSTONE GRIT.

The Gannister question, however, is a very small one compared with those raised by the next lower member of the geological table—the Millstone Grit.

Almost everywhere the Coal Measures (with or without Gannister) overlie an unproductive Farewell Rock, formed of conglomerates and grits, so coarse as frequently to justify the term Millstone Grit. It so happens that in England, where it was first studied, this rock attains an enormous thickness, and being in this country placed between a strongly marked calcareous and a most useful coal-bearing series, it acquired at once very distinct recognition as the great middle member of the Carboniferous system. Wider knowledge has, however, failed to show that the most marked characters of the Millstone Grit are of anything but local value. Even in Britain it is frequently absent altogether in places where both the limestone and coal beds are present in their normal condition. In America, where it has for years been the custom to regard it as being represented by a bed known as the Great Conglomerate, the latter is now shown to be sometimes underlain, as well as overlain, by true

Coal Measures, and the division, as a leading one, appears to be in consequence justly discredited.\* Again, on the continent a large majority of the small detached coal basins, which lie unconformably upon older rocks (Silurians, and what not), have at their base a set of coarse conglomeratic beds, similar to our Millstone Grit in their relations to the coal-bearing series ; but here, where the lower conformable calcareous series is absent, and where these coarse deposits evidently graduate into the finer sandstones which accompany the coals, it is certainly not usual to label the conglomerates Millstone Grit, or in any way to differentiate them from the Coal Measures, of which they represent simply the rough beginning. In Belgium, the place of the Millstone Grit is taken by a thin series of Ampelites or Alum shales, which, if the ordinary tri-partite division of the Carboniferous be enforced, has to do duty for the great mass of our Ingleborough grits.

In Northumberland the place where the Millstone Grit should be, undoubtedly exists, but the grits themselves are sadly deficient, both in character and thickness. Shales, shaly sandstones, and sandy shales, with a few beds of sandstone, seldom coarser in grain than many beds in the Coal Measures, and not nearly so coarse nor so thick as some of the grits of the limestone series below—these, in considerable spreads between the Derwent and the Tyne, and in a narrow band from the latter river to the sea near Warkworth, are the component parts of the Northumbrian Millstone Grit. This miserable representative of the great hill-capping deposit further south would never have been recognized as a chief division here had Northumberland been an island, and had not the traditions of its greatness come from elsewhere. In fact it may be affirmed that the Millstone Grit has, as it were, traded on its thickness. In Northumberland it is thin where it enters the county to the south, and it is much thinner where it leaves it on the East Coast ; it has here no lithological character which it does not share with members of the series above and below ; it has no distinctive fossil remains ; in short, it has nothing peculiar to it but its position. Why then regard it as being anything more than the Gannister beds, a portion of the base of the Coal Measures ?

\* The latest writer on this subject says :—" In view of this confusion, I think all will agree with me that the terms Millstone Grit and Coal Measure Conglomerate should either be used to designate a uniform horizon in the Carboniferous system, or be abandoned as geological terms and retained only for their lithological meaning."—Professor E. B. Andrews, in " American Journal of Science and Arts," Series 3, Vol. x. (1875), p. 290.

True, this Millstone Grit of ours is the attenuated continuation of beds, which, elsewhere (Yorkshire, &c.,) yield occasionally marine remains of species characteristic of the Limestone Series, and this it was probably which induced Sir Roderick Murchison to class it together with the uppermost beds of that Series as the Middle Carboniferous. But it must be remembered that similar marine forms have been found in the true Coal Measures of Coalbrookdale, at Ryhope, in the Durham Coal-field, at seven horizons in the Mons Coal-field, in Belgium,\* and plentifully in the Upper Coal Measures of the United States. It will, therefore, be seen that the fossil evidence, which would tend to unite the Millstone Grit with the Lower rather than with the Upper Series, would apply equally well to connect the Coal Measures proper with the Limestone division.

Taking all these facts into consideration, the writer hopes not to meet with much opposition, if he ventures to place the Millstone Grit of Northumberland in the same category as the Gannister beds; that is to say, as the lowest member of the Coal Measure or Upper Carboniferous group.

Another difficulty now crops up as to where the base limit of the Millstone Grit should be drawn. The top of the highest limestone of the Limestone Series would seem to offer a good common-sense boundary line. This, however, has not been adopted in drawing up the Geological Survey maps of the district. In these maps a considerable but variable thickness of shale and sandstone has been excluded from the Millstone Grit, in accordance, it is believed, with what obtains far away in typical Yoredale areas. But when the extreme variations are considered to which such deposits are subject, even in very short distances, and when further known that this variability increases as it is proceeding from south to north, there is seen to be at least a *primâ facie* objection to the course followed. The narrow zone referred to, may or may not belong to the Limestone Series as it is found elsewhere, but here, in Northumberland, where it comprises the well-known massive sandstone worked at Harlow Hill, on the line of the Roman Wall, there is no evidence to support that view, and the *facies*, or general aspect of the band, is in every way identical with that of various members of the Millstone Grit. Besides which, the impossibility of finding in any but rare and exceptional cases a natural top limit for this set of beds, in a country where the Millstone Grit is so degenerate, would of itself lead one to regard it as being the lowest member of that formation.

\* See Cornet and Briart in "Bulletin de l'Académie royale de Belgique," Série 2, T. xxxiii., No. 1, 1872.

## BERNICIAN SERIES (YOREDALE ROCK AND SCAR LIMESTONE BEDS).

By acting upon the view just propounded a sharp and well-defined line of junction is obtained, separating the lowest division of the Upper Carboniferous—the Millstone Grit—from the Limestone beds, the latter being fitly heralded in by their first or highest calcareous band—the Felltop Limestone. And this is the first perfectly clear line of division to be met with in the Carboniferous System as it occurs in Northumberland.

The writer believes that he has sufficiently shown elsewhere that the Yoredale Rocks of Phillips have no claim to recognition as a separate division in this part of England. He will, therefore, merely point out briefly the chief facts on which his opinion, which he is glad to know is shared by some of the most competent judges, is based. These are:—First, the intrusive character of the Great Whin Sill, and its consequent uncertainty of horizon. Secondly, the impossibility of tracing the Tyne-bottom Limestone for any considerable distance to the north. Thirdly, the similarity in the fossils in the so-called Yoredales and in the Scar Series in Northumberland.\* Having thus called attention to the worthlessness of the usually accepted lower limits of the Yoredale series, he proposed its abandonment as a special member of the Northumbrian Carboniferous, and that it should, together with the so-called Scar beds below, be united into one great formation, to which the name “Bernician” might appropriately be attached, denoting the state of things occurring in Bernicia, as distinguished from that obtaining in Scotland on the one hand and in Yorkshire on the other.

This arrangement also abolishes Mr. Tate’s Calcareous and Carbonaceous groups. Had that able North Country geologist had the opportunity of studying the beds of the southern half of the county as closely as he did those of the northern, the writer feels sure that he would have seen the inapplicability of these groups to the whole district. Still, however, their convenience may be allowed for a limited tract, and the fact that he placed the junction between them very much below the supposed base of the Yoredales is another proof, were any required, of the unsatisfactory nature of the latter term.

\* See Lebour “On the Limits of the Yoredale series in the North of England.” Read at the Bristol Meeting of the British Association, 1875. Published in full in “Geological Magazine,” Decade II., Vol. ii., No. 11, November, 1875.

## TUEDIAN SERIES—VALENTIAN OF GEIKIE (MS.), OR CALCIFEROUS SANDSTONE OF MACLAREN.

Once more we are brought up by the difficulty of finding a base for a series. What is the bottom bed of the Bernician division? At some places within the county the question seems easily answered. The Harbottle grits, in the upper Coquet, and the Great Dour grits, in the burn-valleys running from the north into the upper Redewater, form a lower line very distinct from the Tuedian purple shales and cream-coloured beds upon which they rest. But to the east and north of these localities the boundary fails us. These marked grits soon disappear, and the Tuedians gradually encroach upon the Bernicians from S.W. to N.E. One of two things takes place here. Either the Bernicians as a whole, thin out in a remarkable degree, in which case the grits line must be a true boundary whether the grits themselves continue or not (and this is the view which has hitherto been acted on), or the lower portion of the Bernician series merges by degrees laterally into the Tuedians, when the grits line would merely be one of the merest local use.

There are several facts which induce the writer to advance the last hypothesis as being probably the true one. At all events its assumption renders many things clear which are obscure otherwise. The tolerably thick limestones, purely Tuedian in character, of Hetchester and elsewhere, to the north of Coquet, if followed from north to south, are seen to strike towards the lower Bernician mass, and similarly, some of the numerous limestones of the latter strike from south to north apparently into the Tuedians. Again, in Western Mid-Northumberland, where the Tuedians proper are not known, many limestones of the usual Carboniferous Limestone type alter suddenly in character for a greater or less distance, and assume a *facies* indistinguishable from that of Tuedian limestones, and at the same time, from richly fossiliferous, become nearly or wholly devoid of fossils. The sandstones, on the other hand, are alike in both divisions, contain the same plant-remains, and form similar features. It is only when the very flanks of the porphyritic mass of the Cheviots are reached that the Tuedian beds assume the red hue and coarse structure which are characteristic of the Scottish Calciferous Series—the coarse grain being with us derived in a great measure, if not entirely, from the porphyry, of which fragments are indeed found disseminated in the grits.

That the Tuedians should cease to be looked upon as entirely below all rocks of Carboniferous Limestone age is not such an innovation as it may appear to be at first sight. For, if Mr. Goodchild is right in his suggestion that the Roman Fell Conglomerates in Westmorland may be



the representatives of the Scottish Calciferous beds (a view also held, it is understood, by Mr. James Geikie, F.R.S.), that horizon is, in parts of the Vale of Eden, underlain, as well as overlain, by true undoubted Carboniferous Limestone.\* (See Section No. 111, Plate LXXI.)

As far, therefore, as Northumberland is concerned, the writer would give to a line separating Tuedian from Bernician beds merely the kind of value that would attach, in a map of our present sea-bottoms, to a boundary dividing the sands and muds off the British coasts from the contemporaneous globigerina ooze of the deeper ocean.

To the north the dividing line is a good one, and it would be difficult to say at what point in its southward course it ceases to be so; but here again there is good reason for believing that Northumberland affords the "passage" locality between two members of a great series. A zig-zag, broken, and indefinite line is all that one feels justified in using to define the Upper Tuedian limit in this county.

The base of the Tuedians we do not know here, as we cannot admit that the so-called Upper Old Red Conglomerate, mapped by Mr. Tate, as occurring at Biddlestone, Roddam, &c., on the flanks of the Cheviots, is anything more than part of the Tuedian series—at least on the evidence as yet adduced. Should these beds be ultimately proved to be really Upper Old Red, no great mistake will have been made by the writer in awaiting the event, since he is able to quote the following words from a report of a very recent paper read by Professor A. Geikie, F.R.S., on the Old Red Sandstone:—"It has been abundantly proved that there was contemporaneously [with the Upper Old Red], in the clear seas outside, the fauna which characterized the Carboniferous Limestone.†

#### CONCLUSION.

The changes advocated by the writer in the course of this paper may be summarized as follows:—

- 1.—That the Coal Measures proper, the Gannister beds, and the Millstone Grit, as far down as the Felltop Limestone, should be grouped together as stages of the Upper Carboniferous in Northumberland.

\* J. G. Goodchild, F.G.S., "On the Carboniferous Conglomerates of the Eastern Part of the Basin of the Eden."—*Quarterly Journal of the Geological Society*, Vol. xxx., 1874, p. 394.

† "Colliery Guardian," March 3rd, 1876, p. 345.

- 2.—That the Yoredale Rocks, the Scar Limestone Series, the Calcareous group, and the Carbonaceous group, be abolished, as incapable of natural division, and that the beds comprising them be blended together, into one great Series, the "Bernician," forming the upper member of the Lower Carboniferous in Northumberland.
- 3.—That the so-called Upper Old Red, in this county, be merged into the Tuedian Series, and that the two together form the lower member of the Lower Carboniferous in Northumberland.
- 4.—That the divisional line between the Tuedian and the Bernician, being one which here separates conditions of deposition rather than rigid horizons, be regarded as a variable one in Northumberland.

The appended table will further illustrate the proposed changes.

TABLE—CORRELATING PROPOSED DIVISIONS WITH OLD ONES.

NORTHUMBERLAND, PROPOSED.			SYNONYMS.	
CARBONIFEROUS.	UPPER.	COAL MEASURES.	Coal Measures.	Upper Car-boniferous.
		GANNISTER BEDS.	Gannister Beds.	
		MILLSTONE GRIT.	{ Millstone Grit and Carboniferous Limestone in part.	Middle Car-boniferous.
	LOWER.	BERNICIAN.	{ Yoredale Series and Calcareous Group in part.	
			{ Scar Limestone Series and Calcareous Group in part, <i>plus</i> Carbonaceous Group.	Lower Car-boniferous.
		TUEDIAN.	{ Calciferous Sandstone, or Tuedian, or Valentian, and Upper Old Red Conglomerate in part.	

In Plate LXX. will be seen, in a somewhat diagrammatic form, the stratigraphical changes undergone by the Carboniferous Series from Derbyshire to Berwickshire, on which the views brought forward in this paper are based.

Mr. BOYD stated that he had chiefly hitherto confined his observations to those narrower portions of Northumberland that were situated between Belford and Berwick. It would be very interesting to him if Mr. Lebour

could give them his opinion as to the probable effect which the protrusion of the great plutonic mass of the Cheviots has on the horizontal strata of the mountain limestone through which it had passed. At Roddam, a point where contact would most decidedly have taken place, he had searched diligently for traces which would have enabled him to have solved the question, but the juncture at this point seems to have been overlaid by a sort of conglomerate composed of broken and water-worn porphyritic masses, probably derived from the Cheviots themselves, which had rolled down the Roddam valley. The upper portion of this conglomerate seems almost like debris, which had fallen from the sides of the hills, and which had been compressed by means of a matrix into a solid mass afterwards. He had not followed Mr. Lebour through the points of his difference of classification. It may be that the mountain limestone requires such subdivisions as geologists have in many other cases adopted.

Mr. SIMPSON asked Mr. Lebour if he were quite satisfied that there were gannister beds below the Brockwell Seam on the Tyne, and if so, was he able to compare them with the gannister beds in Yorkshire, and with those which he believed were found in the Auckland district, and if he had personally examined and satisfied himself on the point. So far as he at present knew, in the river Tyne district, the result of all explorations below the Brockwell proved, that no gannister beds existed there, and this was supposed also to be the same in the Auckland district, where a bore hole had lately been put down 100 fathoms below the Brockwell, near Tudhoe; and he understood the gannister beds had not been reached.

Mr. BOYD—The bore hole is not far from Sedgefield. It penetrates through the lowest of the coal-measure series—then through the millstone grit, and displays the mountain limestone with shells existing in it. The bore hole was not made with any intention of exploring the gannister beds, and its chief importance is, that it proves where the last trace of coal is to be found on the southern edge of the county of Durham. The gannister beds are very well displayed in the West of Durham, as the pure limestone grit is approached.

Mr. WARINGTON SMYTH had had the opportunity of frequently exploring the counties of Northumberland and Cumberland, and it appeared to him that, when the limits of the various subdivisions, which Mr. Lebour had presented to their observation, were approached, a large field for consideration was opened out, and that many difficulties prevented those hard and fast lines being drawn which he considered more or less necessary in all geological descriptions. The more these districts

are visited the more it is found desirable not to attempt to draw these lines with too great precision, but rather to leave them open for much future consideration. Whilst listening with much interest to the paper, he had felt that there was a tendency to upset those old broad lines of division, and introduce new terms, which possibly a more minute examination of this interesting district may render unnecessary. The question if the mountain limestone itself follows downwards to those upper portions of the old red sandstone, no doubt offers a very large field for further research, and Mr. Lebour has done good service if he has only been the means of pointing out the difficulty attendant on the solution of the question. He was sorry he had not had an opportunity of personally examining the western portions of Northumberland, or those which are bordering on Scotland, but with regard to those beds which are found in Alston Moor, and cropping out on the sides of Cross Fell, he thought that much attention should be paid to the considerations which had been brought forward in the paper. At the same time, he felt sure that there were many who would be most desirous of only making such changes in the received mode of nomenclature as can be applied to other districts. Passing into Scotland, these lower measures become of very high commercial importance, and, therefore, every proposal to create new subdivisions should be very cautiously considered. Those vast lower carboniferous formations, which recently have attracted attention in Russia, and which occupy an area of many hundred miles in length and of considerable breadth, can only be judged of by the experience obtained from Northumberland and parts of Scotland; and the exact knowledge of these districts will not only be of great advantage in settling questions with regard to coal measures of this country, but also in considering those of foreign countries, especially in those parts where there is reason to believe that a deeper limit may be obtained by what might be called the different distribution of the deposits, which appear to have commenced at a much earlier date than those in our own country. He had that day received a communication from Professor Van Beneden, to the effect that recent bore holes had reached the coal measures in the northern part of Belgium, where it had been thought impossible for them to exist. These borings had been undertaken, in consequence of the extraordinary folds, which had been shown to bring coal measures to a workable distance from the surface, in the valley of the Ruhr, and which has extended that coal-field to an additional 60 kilometers in width. When it is considered how large a tract of ground has been thus added to the available coal measures of Belgium and Germany, it shows that very material modifications may

have to be made in respect to the consideration of those coal-fields which are overlaid by newer rocks.

Mr. LEBOUR, with reference to Mr. Boyd's remarks as to the debris overlapping the junction between the lower Carboniferous beds and the porphyritic mass of the Cheviots, thought they were probably conglomerates similar to that which Tate looked upon as the upper Old Red conglomerate. He believed the porphyritic mass was intruded long before the deposition of any Carboniferous beds whatever, that the mass had since been frequently upheaved, and that this accounted for the great inclination of the Carboniferous strata as they came upon the flanks of the Cheviots. In some cases, as for instance up the Riddlees burn, the Carboniferous strata were lying flat and undisturbed upon the porphyry, although a few miles off they were found nearly vertical. He was glad to hear from Mr. Simpson that no true gannister beds had been found by him in Northumberland, for that completely confirmed his view. In the woods at Chopwell a boring was made to some 300 feet below the Brockwell Seam, and the whole result of that boring consisted of shales and sandstones, with the addition of a little coal, too thin to be worked. Of course, in talking of gannister beds in Northumberland, he meant the beds which occupy the horizon which that stone occupies in Yorkshire, and in the typical gannister district. In answer to Mr. Warrington Smyth, he had been under the impression that, instead of coining new divisions for the Carboniferous rocks in Northumberland, he had been grouping a number of subdivisions which had been previously made on apparently insufficient grounds, into larger ones, which would come in accord with the general features of the formation, and so facilitate the work of the geologist. He pleaded guilty to the introduction of the word "Bernician," but "Northumbrian" would do nearly as well.\*

Mr. BEWICK moved a vote of thanks to Mr. Lebour for his valuable paper, which was unanimously agreed to.

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Messrs. Hall and Clark's paper on "The Mechanical Effect of 'Blown-out Shots' on Ventilation," was considered as read, and ordered to be printed.

\* The word "Bernician" has a narrower and more exact meaning in this connection than "Northumbrian," which, in its wider sense, includes a much greater extent of country than is characterized by the geological features to which I have applied the former term.